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NATIONAL DAM INSPECTION PROGRAM. BIRCH RUN RESERVOIR DAM (NDS I--ETC(U)
JUN 78 DACW-31-78-C-0044
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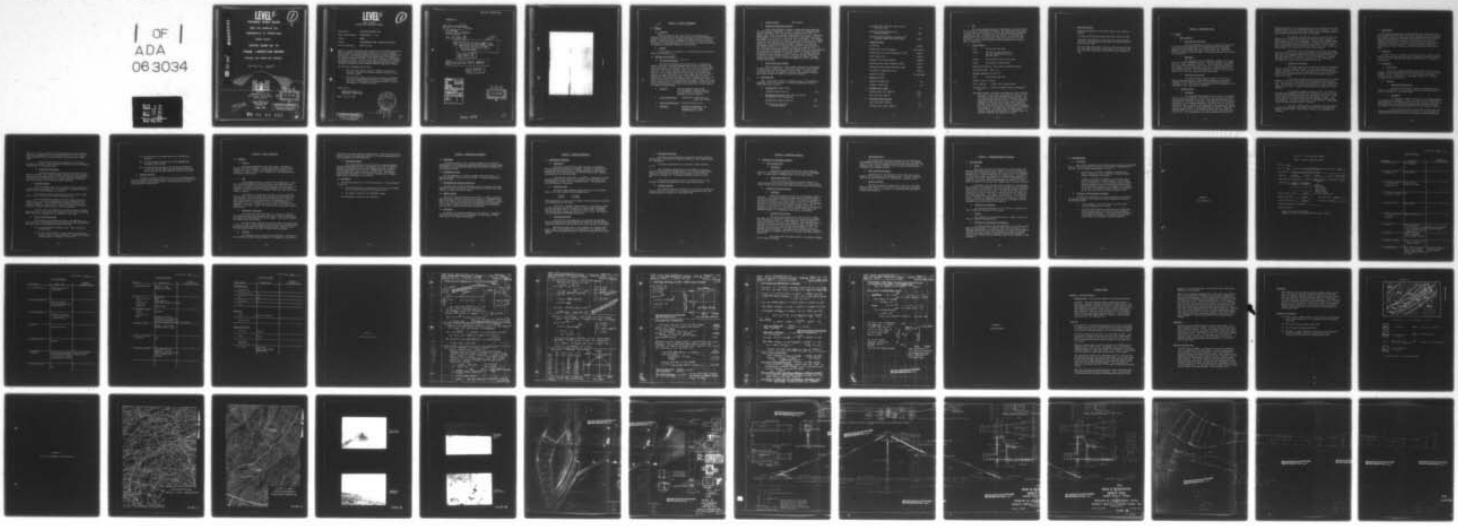

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LEVEL II

(1)

POTOMAC RIVER BASIN

BIRCH RUN RESERVOIR DAM

COMMONWEALTH OF PENNSYLVANIA

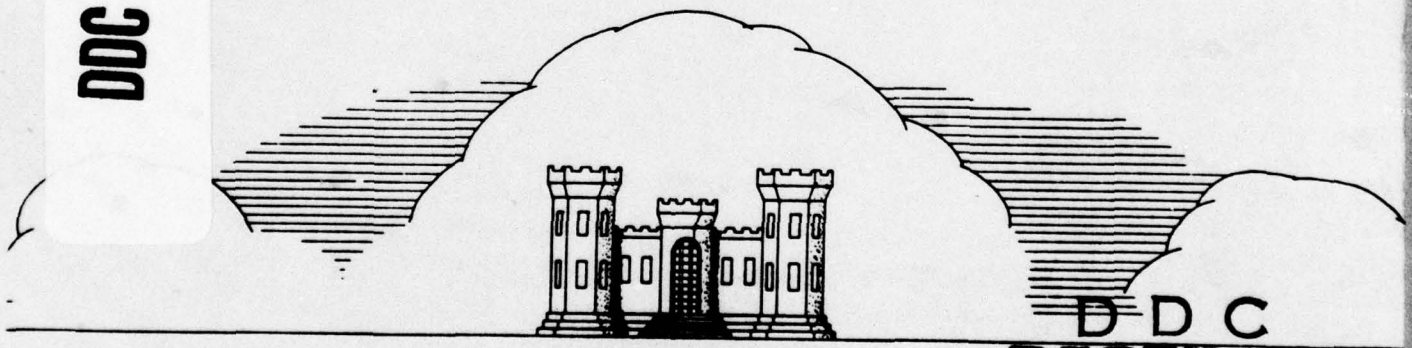
ADAMS COUNTY

INVENTORY NUMBER NDS 329

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DACW 31-78-C-0044 new



Prepared For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland

by
BERGER ASSOCIATES, INC.
CONSULTING ENGINEERS
HARRISBURG, PA.

JUNE 1978

411003

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LEVEL II

(1)

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	BIRCH RUN RESERVOIR DAM
State & State Number:	PENNSYLVANIA - 1-69
County:	ADAMS
Stream:	CONOCOCHEAGUE CREEK, POTOMAC RIVER BASIN
Date of Inspection:	APRIL 20, 1978

Based on a visual inspection, past performance and available engineering data, the dam and its appurtenances appear to be in fair condition. However, Phase I hydraulic computations indicate a serious inadequacy of the spillway. The recommended spillway design flood (SDF) should be the Probable Maximum Flood (PMF). The actual capacity is approximately 36 percent of the PMF. In the event of heavy precipitation, an around-the-clock surveillance plan and a downstream warning system should be implemented immediately until permanent remedial measures are taken.

The following recommendations are made:

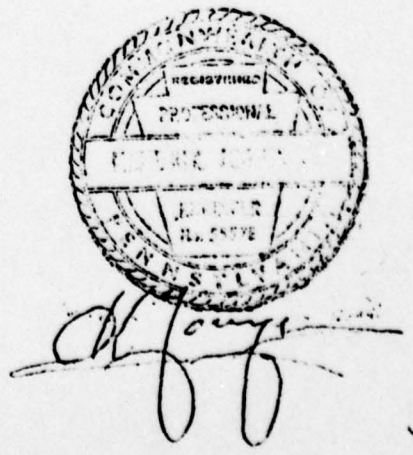
1. The owner shall breach the dam or propose an alternate solution to improve the spillway adequacy within an acceptable time period.

2. The owner shall engage an experienced engineer to determine the cause of seepage and the effect of the seepage on the safety of the dam and make the necessary repairs to reduce the seepage to tolerable quantities.

Submitted By:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

Date: June 15, 1978



APPROVED BY:

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

DATE: 27 Jun 78

(6) National Dam Inspection Program. Birch Run Reservoir Dam (NDS ID Number 329), Potomac River Basin, Conococheague Creek, Adams County, Pennsylvania. Phase I Inspection Report.

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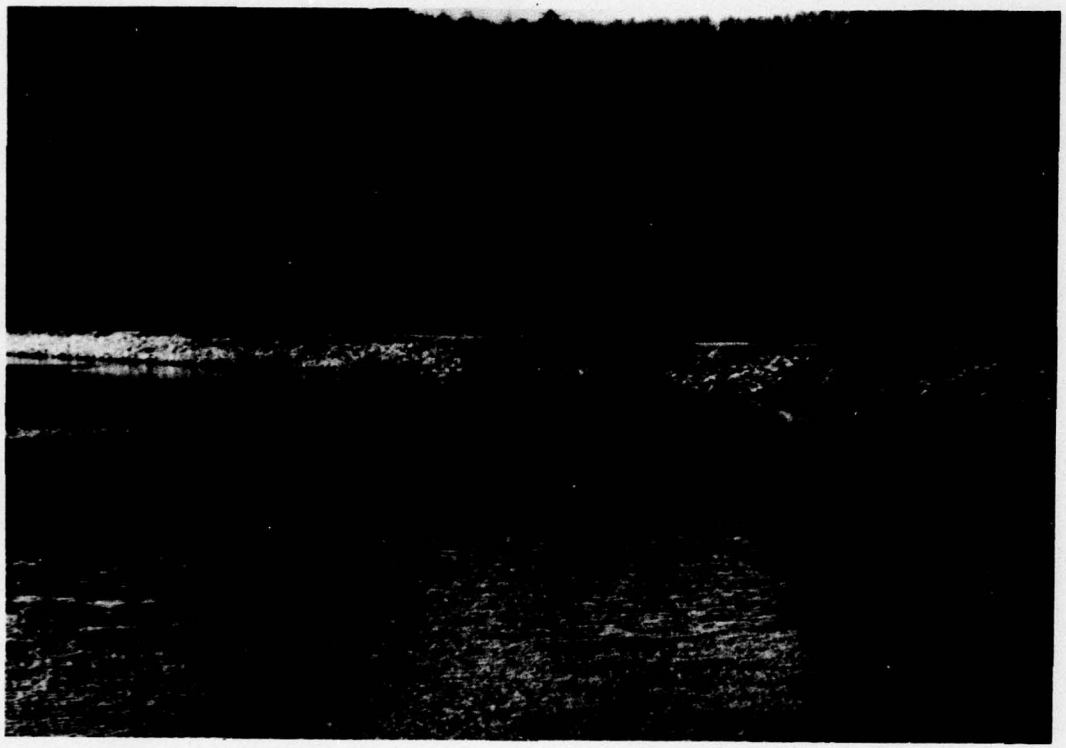


OVERVIEW

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Dam Inspection Act, Public Law 92-237 (Appendix III) authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspections of dams throughout the United States. Phase I Inspection and Report is limited to a review of available data, a visual inspection of the dam site and the basic calculations to determine the hydraulic adequacy of the spillway.

b. Purpose

The purpose is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances

The Birch Run Reservoir Dam formerly known as Chambersburg Reservoir Dam has an pervious embankment section with a concrete core wall in the center. The length of the crest is 670 feet and the height of the dam from bottom creek bed to top of dam is 63 feet (Appendix D, Plate VI). The as-built drawings indicate the top dam elevation at 1099.75, U.S.G.S. datum, which is 3.75 feet lower than project datum. A spillway has been constructed in the north (right) abutment with an elevation of 1088.0 (project datum)). The weir length is 115 feet. An intake tower is located at the upstream side of the dam and is accessible by a footbridge. All gate controls are located on this tower. The outlet conduit is a 30 inch diameter cast iron pipe. The dam is located 1.5 miles downstream from the Long Pine Run Dam, which is also owned by the Borough of Chambersburg.

b.	Location:	Franklin Township, Adams County U.S. Quadrangle, Caledonia Park, Pa. Latitude 39°55.1', Longitude 77°27.3' (Appendix D, Plates I and II)
c.	Size Classification:	Intermediate (1,560 Acre Feet, height is 63 feet)
d.	Hazard Classification:	High (See Section 3.1.e)
e.	Ownership:	Borough of Chambersburg, Pa. 100 South Second Street Chambersburg, Pa. 17201

f. Purpose of Dam: Water Supply

g. Design and Construction History

The dam was designed by Gannett, Seelye and Fleming Engineers, Inc., Harrisburg, Pennsylvania, in 1932. A permit for construction was granted in December, 1932, and construction was started in 1933. In August, 1933, a heavy rain caused a large washout at the site. The washout caused damage to the core wall and in the area of the proposed spillway. The damage to the core wall occurred near the left abutment. Two sections were pushed over and had to be replaced. Some other sections were slightly tilted and a seal was placed on the upstream side to seal the joint. The washout at the proposed spillway required a redesign of the spillway. The redesign consisted of a slightly lower profile on the centerline of the spillway and the use of transverse cutoff walls under the slab. In 1937, the waste channel and spillway were heavily eroded and a reconstruction of the spillway was designed by Mr. Crosby Tappan, a Consulting Engineer. Reconstruction was completed in December, 1937. The spillway chute was resurfaced in 1960 and again in 1962. Plans for further rehabilitation of the spillway and stilling basin were prepared by Gannett, Fleming, Corddry and Carpenter, Inc., in 1971 and completed in 1972, just before tropical storm Agnes.

h. Normal Operating Procedure

The dam functions as a water supply reservoir for the Borough of Chambersburg, Pennsylvania. The actual intake for the water supply is located about one mile downstream from the dam. If there is not sufficient flow over the spillway to satisfy supply demands, releases can be made through the conduit to satisfy this demand.

1.3 PERTINENT DATA

Note: Except where noted, all elevations used in this report are referenced to the project datum. To convert elevations to mean sea level datum, add 3.75 feet.

a. Drainage Area (square miles)

(original design used 14.7)	14.3

b. Discharge at Dam Site (cubic feet per second)
See Appendix B for calculations

Maximum known flood at dam site	750
Warm water outlet at pool elevation 1088.12	110

Diversion tunnel low pool outlet at pool elevation 1,035	40
Diversion tunnel outlet at pool elevation 1088.12	160
Maximum spillway capacity at maximum pool elevation 1096.0 feet (top of dam)	9,300

c. Elevation (feet)

Top of dam	1,096.0
Maximum pool design surcharge	None listed
Maximum pool of record (September 26, 1975)	1,089.6
Water supply pool	1,088.12
Spillway crest (uncontrolled)	1,088.12
Upstream portal invert diversion tunnel	1,031.0
Downstream portal invert diversion tunnel	1,030.0
Streambed at centerline of dam	1,033.0
Maximum tailwater	Not Available

d. Reservoir (miles)

Length of maximum pool	0.9
Length of normal pool	0.8

e. Storage (acre - feet)

Spillway crest (El. 1088.12)	1,040
Top of dam (El. 1096.0)	1,560

f. Reservoir Surface (acres)

Top of dam (Elev. 1096.0)	77
Spillway crest (Elev. 1088.12)	55

g. Dam

The design drawings indicate an embankment with a breast width of 12 feet and a top elevation of 1096.0. The slopes, which are 2.5H to 1V below elevation 1066 and 2H to 1V above that elevation are protected by 18-inch rip rap. The impervious core consists of a concrete wall tapered from 3 feet at bottom to two feet at top. The core wall was designed to be set on rock and stops seven feet below the top of the dam. For a general plan and typical section see Appendix D, Plates V and VI respectively.

h. Outlet Conduit

Type - 30-inch cast iron pipe.

Length - 100 feet upstream from tower.
185 feet downstream from tower.
285 feet total.

Closure - Sluice gate on inlet and on outlet.

Access - Foot bridge to intake tower.

Regulating Facilities - Sluice gates, manually operated.

Maximum Discharge - 160 c.f.s.

i. Spillway (Appendix D, Plate VII)

Type - Uncontrolled ogee weir.

Length of weir - 115 feet.

Crest elevation - 1,088.12 feet, project datum.

Upstream channel - Unlined rectangular channel excavated in rock.

Downstream channel - Original chute washed out below elevation 1072 feet in 1936 or 1937 and was rebuilt with a new configuration. The present arrangement is as follows: For the first 200 feet the chute has a relatively flat slope and maintains the width of the weir. It then narrows and steepens for about 100 feet at which point the flow is delivered to a flight of about seven 4-foot-high steps. From the bottom of the steps, the water flows in a narrow, deep channel to a stilling basin and thence to the natural stream channel. The entire chute is constructed of concrete. Concrete training walls of suitable height are provided throughout the length of the chute.

j. Regulating Outlets

Water may be admitted to the control tower at two levels as follows:

A 20-inch by 36-inch sluice gate with invert elevation 1066.

A 100-foot-long 30-inch cast iron pipe with invert elevation 1031 feet. This pipe has a sluice gate at the point where it enters control tower.

The only outlet from control tower is a 185 foot long 30 inch cast iron pipe fitted with a sluice gate at the control tower end. The invert elevation of the outlet end of the pipe is 1030.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

a. Data Available

1. Hydrology and Hydraulics

The only hydrologic or hydraulic information in the files of the Pennsylvania Department of Environmental Resources (PennDER) consisted of the drainage area (14.7 square miles), the impounding capacity (1,040 acre-feet) and the lake area (50 acres). The latter data is to spillway elevation 1088.0. The spillway capacity was reported to be 9,500 cfs.

2. Embankment

The information for the embankment consists of a general plan and a typical embankment section. Some core borings in the valley are on the plans (Appendix D, Plate VI). The borings were located 40 feet upstream from the centerline of the dam. A drawing dated October, 1934, shows a record of the grout curtain and the bottom elevation of the concrete core wall. This record drawing is based on *U.S.G.S.* datum which is 3.75 feet lower than the project plan datum.

3. Appurtenant Structures

The design drawings indicate details of the control tower, conduit and spillway. The spillway drawings were revised in September, 1933 (Drawing I-3822-A) and other drawings indicate the revisions of 1937. New plans for rehabilitation of the spillway in 1972 were added to the files and are available.

b. Design Features

1. Embankment

The design drawings indicate that the area of the embankment fill was to be stripped. A trench was to be excavated to the top of rock on the centerline of the dam. After placing a vertical 3-inch steel pipe in the center of the trench, the trench was to be filled with concrete up to the original groundline. Then holes were to be drilled through the pipe to a depth to be determined by the engineer and filled with grout. The drawing of record indicates the depth of trench and the bags of cement per hole. This drawing indicates that the trench was excavated about 8 feet into rock and that the trench width varied from 3'6" to 5'0". The overburden in the valley was about ten feet thick.

During construction, it was discovered that the rock surface on the left abutment (south side) was considerably deeper than anticipated. Grouting was not done in this area and the concrete core wall was placed on soil after excavating a maximum of 15 feet of overburden.

The concrete core wall has a base of three feet and a top width of two feet and stops seven feet below top of dam. Details of reinforcement or keys are not indicated. Construction photographs show keys between pours, but no reinforcement. During a heavy rain in August, 1933, a considerable washout occurred on the left side of the valley. Some concrete core walls were broken and others were tilted. Scabs were placed against the tilted walls to close the open joints.

According to one of the reports in the files, the embankment material had a lot of impervious material, but also pockets of sand and rocks. The embankment has the same slopes upstream and downstream. Below elevation 1066, the slopes are 2.5H to 1V; above that elevation, the slope is 2H to 1V. There is a stone fill at the downstream toe. The slopes are covered with an 18 inch thick rip rap.

2. Appurtenant Structures

The intake tower is set on rock and consists of reinforced concrete walls of varying thickness. A trench was excavated under the conduit, presumably to rock. The trench was filled with concrete and a 30 inch cast iron pipe, encased in concrete was set on top of this wall. Twelve inch cutoff collars are shown at 20-foot intervals along the length of the pipe.

A 115 foot long ogee section was constructed at the right abutment. The hillside was excavated to accommodate the spillway and weir. The weir has a 7 foot deep cutoff wall and is shown as keyed into rock. The spillway chute and sloping sidewalls were paved with 12-inch grouted stone in 1933. Concrete cutoff walls were provided at 50-foot centers.

A considerable washout occurred in 1937. As a result a new chute was designed and constructed of reinforced concrete starting about 100 feet downstream from the weir (Appendix D, Plate VII). Steps in the chute were constructed where the deep washout occurred. The total length of the chute is about 630 feet including an 80-foot long stilling basin. The chute narrows down to about 29 feet. A footbridge across the chute provides access to the dam.

The weir, spillway chute and stilling basin were gunited in 1972, and therefore, the spillway crest elevation is assumed to be 1088.12, project datum. (The elevation shown on the reconstruction drawings).

2.2 CONSTRUCTION

The general appearance of the dam indicates that construction was made as described above. Construction data available for review included the original contract drawings, the revised spillway designs in 1933 and 1937, and rehabilitation of spillway in 1960 and in 1972. The record drawing of grouting and core wall is very valuable as are the many construction photographs. The main deviation from the original plan is the omission of a grout curtain on the left side and the decision to place the core wall in that area on overburden material rather than on rock.

2.3 OPERATION

The dam is part of a domestic water supply system. Records of high flows over the spillway are kept, but the readings are made by placing a rod on the crest of the weir and reading the flow level. Accuracy is questionable.

2.4 EVALUATION

a. Availability

A full set of design drawings were available in the files of PennDER. These design drawings are very general with very little details. Drawings for the rehabilitation in 1972 were obtained from Gannett, Fleming, Corddry & Carpenter, Inc., and added to the file. No design calculations were in the files.

b. Adequacy

1. Hydrology and Hydraulics

There was no hydrology or hydraulic information in the files. The permit application indicates a maximum design surcharge over the weir of 9,500 cfs. (to top of dam).

2. Embankment

The embankment design, as indicated on the design drawings, is considered to be adequate. It was noted that no keys or waterstops were indicated in the construction joints of the core wall. Construction photographs indicate that keyed joints were used, but waterstops were not noticed. The size of the cutoff collars on the conduit are minimal.

The concrete core wall was not placed on rock in the left abutment and grouting was not done in this area. It is suspected that this condition has caused and is still causing considerable seepage in

that area. Little information is available about the type of material used for the embankment, but some reports indicate that the material varied from impervious to sand and stones with large stones in many cases.

Several boring records are available for test holes drilled in the valley. Only one boring was drilled in the left abutment area and none in the spillway area.

3. Appurtenant Structures

Design calculations and design criteria were not available in the files. The contract drawings indicate the type of construction and the reinforcement used. If all structures are constructed as indicated and a concrete strength is assumed, sufficient information would be available to review the structural capacities.

c. Operating Records

The files indicate that, over the years, several problems have occurred with the spillway chute. The records of the manager indicate that no recent heavy discharges have occurred.

The tropical storms of Agnes (1972) and Eloise (1975) caused about 1.4 feet of water to flow over the spillway crest.

Due to considerable seepage at the left abutment and at the conduit outlet, weirs have been installed and weir readings for many years are available. These readings were sometimes daily and were sometimes skipped for several years. Original leakage was reported at a rate of 2.8 million gallons per day after construction.

In April, 1935, the leakage was reportedly reduced to 686,000 gallons per day. Many readings are available for 1952, and 1961 through 1964. More recent readings are not available in the files.

d. Post Construction Changes

There have been no modifications made to the embankment, but due to erosion of the spillway, many changes have been made as previously described. The recorded modifications are as follows:

(1) In 1933 redesign of spillway chute. Chute consists of grouted stone.

(2) In 1937 after a washout, concrete steps were constructed and most of the chute was narrowed to a reinforced concrete U-shaped channel. (Appendix D, Plate VII).

(3) In 1944 some of the eroded stone in the spillway was replaced.

(4) In 1960 and 1961 the upper part of the spillway was resurfaced with concrete.

(5) In 1972 the weir and most of the spillway was gunited. In 1972 the lake was drawn down and the intake tower was also gunited and the gate operation stands were replaced.

e. Seismic Stability

The dam is located in Seismic Zone 1 and it is considered that the static stability with normal safety factors is sufficient to withstand minor earthquake induced dynamic forces. No calculations or studies have been made to confirm this.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The general appearance of the dam is fair. According to discussions with the manager, a regular maintenance program is maintained. The visual checklist is in Appendix A of this report and Appendix D, Plates III and IV have reproductions of photographs taken at the time of inspection.

b. Dam

The embankment slopes are protected with dumped stone. There is a considerable growth of trees and brush on the downstream slope. This type of embankment with an impervious concrete core wall is not as sensitive to growth as a normal type of embankment, but such growth should be kept under control. The manager stated that every three years growth is removed.

The slopes were stable and no failures or unusual movements were detected. Several locations had considerable water leakage. One location was on the left abutment about 20 feet above the toe of the dam and approximately 16 feet downstream of the embankment fill. A deteriorated weir for flow measure is still visible (Photograph in Appendix D, Plate IV). Leakage was also noticeable on the top of the headwall of the conduit outlet. The weirs at this location have totally deteriorated.

c. Appurtenant Structures

The intake tower and footbridge are in excellent condition. The operation stands were replaced in 1972 and the tower was gunited on the outside over approximately 10 feet of height. All gates are cracked and greased every three months.

The ogee section, spillway and stilling basin were rehabilitated in 1972, are still in good condition, and seem to operate satisfactorily. The spillway walls below the steps had moved inward. Concrete struts have been placed between the walls to prevent further movement.

d. Reservoir

The reservoir area is clean and well maintained. The banks do not indicate any special erosion problems. The approach to the weir is

shallow but clean and contains no obstructions. Long Pine Run Reservoir, which is owned by the same water authority, is located approximately 1.5 miles upstream of Birch Run Reservoir.

e. Downstream Channel

The channel beyond the stilling basin is a typical mountain stream with heavy growth close to the stream. The creek is located parallel and sometimes close to State Highway Route 233. Failure of this dam could cause loss of life in Caledonia State Park and in several communities located downstream of that park. The economic loss would be appreciable. It is considered appropriate to assign a "High" hazard classification to this dam.

3.2 EVALUATION

The observed condition of the facility was fair. The two points of concern are:

a. The large quantities of seepage out of the toe of the embankment at the left side and at the conduit outlet.

b. The amount of growth on the embankment slopes.

The maintenance of the gates was excellent.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

An interview with Mr. John H. Shadle, Manager for the Borough of Chambersburg for the waterworks indicated that releases are made through the conduit if the spillway discharge falls below what is required for the downstream intake.

4.2 MAINTENANCE OF DAM

The dam embankment is cleared of growth every three years. An approved chemical is used to kill the roots. No other maintenance is made at the dam.

4.3 MAINTENANCE OF OPERATING FACILITIES

The sluice gate stems and operating stands are greased every three months according to Mr. Shadle. All the gates are opened at that same interval to insure operable condition.

4.4 WARNING SYSTEM

There is no formal warning system in effect. To insure sufficient flow downstream, personnel visit the weir regularly. Measurements are made of the depth of flow over the weir during high discharges. However, there is no staff gauge available and the readings are not considered very accurate. There is at present no around-the-clock surveillance plan in effect during periods of high precipitation.

4.5 EVALUATION

The general operational procedures are satisfactory. Although no formal warning system has been established, the facilities are kept under more or less regular surveillance.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

File data available from PennDER contained no information about the hydrologic basis for the design. There was a statement that the spillway will pass 9,500 cfs. Calculations made for this report indicate that the spillway will pass 9,300 cfs with the pool elevation at the level of the top of the dam.

Area-capacity curves were not available. Area-capacity information presented in this report was calculated on the basis of a pool area measured on recent U.S.G.S. topographic maps. The drainage area was also measured on these maps.

b. Experience Data

The water company manager measures the head on the spillway daily. His records indicate the following peaks:

6/23/72	16 Inches
9/26/75	16 Inches

These measurements are made on the spillway crest and should be corrected for estimated drop in the nappe.

The U.S.G.S. operates a gaging station on Conococheague Creek 1.3 miles upstream from this reservoir at a point where the drainage area is 5.05 square miles. For the period 1960 to 1976, the maximum flow reported for this gage was 392 cfs on June 22, 1972. See Section 1.3.b and Appendix B for maximum known flood.

c. Visual Observations

On the date of the inspection, no conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event, until the dam is overtopped.

The 30-inch outlet pipe is not equipped with an energy dissipator. This is not considered to be a hazard but it is probable that there would be considerable erosion if the outlet works were to be fully opened.

d. Overtopping Potential

This dam is 63 feet high and the reservoir can hold 1,560 acre feet of water. This height and capacity indicates a size classification of "Intermediate".

The hazard classification for this dam is "High" (Section 3.1.e).

The Recommended Spillway Design Flood (SDF) for a dam with the above size and hazard classifications is the Probable Maximum Flood (PMF). For this dam, the PMF has been calculated to be 26,100 cfs (see Sheet 3, Appendix B). The maximum spillway capacity is 9,300 cfs.

Calculations in Appendix B show that this dam does not have sufficient storage and spillway capacity to pass even 1/2 PMF.

e. Spillway Adequacy

The spillway capacity is considered to be seriously inadequate, as the project will not pass 1/2 PMF without overtopping the dam. The spillway capacity of 9,300 cfs is only 36% of PMF.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation

1. Embankment

There were no visual observations of undue embankment distress. Considerable seepage exists at the left side of the embankment. A lesser amount of seepage occurs at the conduit outlet.

2. Appurtenant Structures

Visual observations indicate no present stability or stress problems in any of the appurtenant structures. Previous installation of strut beams indicate that walls had been moving on the spillway.

b. Design and Construction Data

1. Embankment

There are no design criteria for the embankment stability available. The borings indicate good foundations for vertical loads, and that the overburden is rather pervious. The failure to continue the grouting and founding of core wall on rock in the left hillside may be the cause of the continuous seepage problem in that area. Other possible causes of this leakage could be a spring, fractures in the rock or fractures in the core wall. The amount of seepage seems to be relatively constant and there is no turbidity in the water. The slopes of the embankment appear to be adequate for this type of construction.

2. Appurtenant Structures

The ogee section appears to be stable and well founded. The upper part of the spillway chute consists of grouted stone and does have a maintenance problem. A reinforced gunite layer was added and should be sufficient to control this condition. The reinforced concrete walls used below the steps have rather small footings. The width of footings is 5 feet for a total wall and footing height of 11'9". The need for struts indicates that the walls were not stable and future problems can be anticipated. The safety of the facility would, however, not be affected by possible erosion of the spillway (See Plan on Plate V, Appendix D).

The intake tower and conduit appear to be properly designed for the expected loadings.

c. Operating Records

The records and past history indicate that the spillway has been damaged several times. The present condition, after the rehabilitation in 1972, should be adequate to pass the expected discharges. The tropical storms of Agnes and Eloise did not produce excessively high discharges and no damage occurred.

d. Post Construction Changes

Modifications to the spillway have been made after serious washouts and deterioration of the spillway slab. Tilting of spillway walls in one area necessitated the installation of precast struts.

e. Seismic Stability

This dam is located in Seismic Zone 1 and it is considered that the static stability is sufficient to withstand minor earthquake induced dynamic forces. No studies or calculations have been made to confirm this assumption.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

The visual inspection and operational history indicate that Birch Run Reservoir Dam is in fair condition. The visual inspection confirmed that considerable seepage still occurs at the left embankment abutment and to a lesser degree near the conduit outlet. The quantity of uncontrolled seepage is considered to be potentially hazardous to the safety of the dam. Depending on the source of the seepage and the different types of material in the embankment or abutment, it could affect the stability of the dam under higher head as a result of piping.

Of primary concern is the serious inadequacy of the spillway. The recommended Spillway Design Flood for this dam is the PMF (Probable Maximum Flood), or 26,100 cfs. The actual maximum spillway capacity to top of dam is 9,300 cfs (36% of PMF). To pass half of PMF it is calculated that the water would have to reach an elevation of 1097.0 (1.0 foot above dam breast). (See Sheet 5 of Appendix B). The discharge over the dam would be about 1,800 cfs with a velocity of 2.6 feet per second. Although the embankment is the pervious type with a concrete core wall and rip rap downstream protection, it is doubtful that the embankment would stand up under this condition.

b. Adequacy of Information

The available information for the facility is sufficient to make a reasonable assessment of the project.

c. Urgency

The inadequacy of the spillway makes it urgent to follow up with the suggested recommendations.

d. Necessity for Additional Investigation

The owner should be notified immediately of the serious inadequacy of the spillway. It is doubtful that a detailed study of the hydrology and hydraulics for this dam could prove the spillway adequate. The owner should also be notified immediately to assess the seepage condition and should engage an experienced professional engineer to evaluate this condition and the possible affect on the stability of the embankment.

7.2 RECOMMENDATIONS

a. Facilities

The serious inadequacy of the spillway would require an engineering study of alternate solutions to improve on the hydraulic performance of this dam. The following recommendations are made:

1. Notify owner of seriously inadequacy of spillway and request breaching of dam or alternate proposed solution within an acceptable time period.

2. If owner is planning to continue to use the dam, weirs should be installed to measure leakage at left abutment and at conduit outlet. A study should be made to compare measured leakage at present with previously known flows and to evaluate the effect of the seepage on the stability of the dam. The seepage should be reduced to a tolerable amount and controlled with properly designed drains.

b. Operation and Maintenance Procedures

Although the maintenance of the dam is sufficient at present, the serious inadequacy of the spillway requires immediate attention to the following items:

1. A staff gauge at a location visible from the roadway should be installed by the owner.

2. The owner should develop a surveillance and formal downstream warning system in the event of high discharges and/or high precipitation. This warning system should be coordinated with personnel of Caledonia State Park and Civil Defense for communities located downstream.

APPENDIX A

VISUAL CHECKLIST

CHECK LIST - DAM INSPECTION PROGRAM

PHASE I - VISUAL INSPECTION REPORT

NAD NO. 329

PA. ID # I-69 NAME OF DAM Birch Run Reservoir HAZARD CATEGORY High

TYPE OF DAM: Earthfill with concrete core wall

LOCATION: Franklin TOWNSHIP Adams COUNTY, PENNSYLVANIA

INSPECTION DATE 4-20-78 WEATHER Cloudy - Cool Showers TEMPERATURE 40's

INSPECTORS: H. Jongsma - R. Houseal
R. Steacy - A. Bartlett D.E.R.
Adli Hanna
Paul Gardosik
Robert Stine
Richard Burdge

NORMAL POOL ELEVATION: 1088.12 AT TIME OF INSPECTION:

BREAST ELEVATION: 1096.0 POOL ELEVATION: 1088.2

SPILLWAY ELEVATION: 1088.12 TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION:

GENERAL COMMENTS:

Slopes are not well maintained.
Leakage occuring in left abutment and at conduit outlet.

DAM NO. NAD 329

VISUAL INSPECTION

EMBANKMENT	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. SURFACE CRACKS	None apparent	
B. UNUSUAL MOVEMENT BEYOND TOE	None apparent	
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	None apparent Dumped rock slopes	
D. VERTICAL & HORIZONTAL ALIGNMENT OF CREST	O.K.	
E. RIPRAP FAILURES	None visible	
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Appears satisfactory	
G. SEEPAGE	Refer to records - Still flowing at leftside Still flowing at outlet (gate closed) above and around end wall	Check flow and compare with past history
H. DRAINS	Pipe at embankment natural grade jointure	
J. GAGES & RECORDER	U.S.G.S. - Weirs also for seepage records	
K. COVER(GROWTH)	Rock - some scattered small trees - brush Growth controlled every 3 years.	Stricter program of growth control

DAM NO. NAD 329

VISUAL INSPECTION

OUTLET WORKS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. INTAKE STRUCTURE	Tower near center of dam breast	
B. OUTLET STRUCTURE	Pipe with endwall. Water seeping above and around endwall	
C. OUTLET CHANNEL	Vertical, stone lined, covered with moss to natural stream	
D. GATES	3 gates on tower	
E. EMERGENCY GATE	Operable	
F. OPERATION & CONTROL	Release flow downstream when spillway discharge is less than 2" to main water supply to intake	Gates are operated every 90 days
G. BRIDGE (ACCESS)	O.K.	

DAM NO. NAD 329

VISUAL INSPECTION

SPILLWAY	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. APPROACH CHANNEL	Shallow - clear Stone lined slopes	
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Small Ogee Good None apparent Some gunite applied to surface Appear sound	
C. DISCHARGE CHANNEL Lining Cracks Spilling Basin Walls	Concrete Sloping to vertical. Some gunite at slab/wall Joint has disappeared. No problem, because wall behind is concrete	
D. BRIDGE & PIERS	Bridge - steel across Spillway outlet channel	
E. GATES & OPERATION EQUIPMENT	None	
F. CONTROL & HISTORY	Many changes due to washouts. In good condition since guniting in 1972. Maximum flow recorded	

DAM NO. NAD 329

VISUAL INSPECTION

MISCELLANEOUS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
INSTRUMENTATION		
Monumentation		
Observation Wells	No	
Weirs	Yes	
Piezometers	No	
Other		
RESERVOIR		
Slopes	Good, no erosion	
Sedimentation		
DOWNSTREAM CHANNEL		
Condition	Natural	
Slopes	Forest	
Approximate Population		
No. Homes	State Park Water supply intake Chambersburg	

APPENDIX B

HYDROLOGY/HYDRAULICS

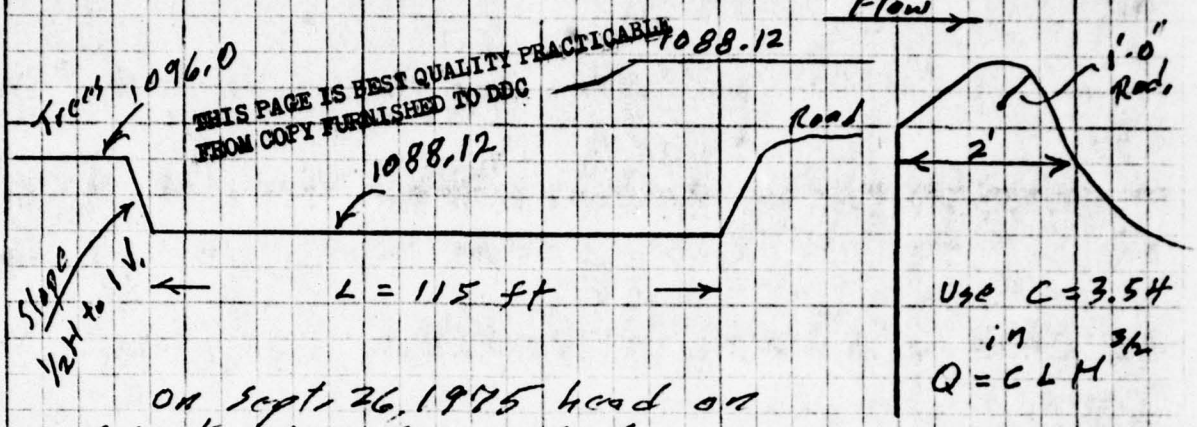
PROJECT Dam Investigation SHEET NO. 1 OF 2

SUBJECT Birch Run Reservoir Dam I.D. No. 329

COMPUTED BY RLS DATE 4-2-78 CHECKED BY JDJr

5-4-78

Maximum known flood at damsite



Use C = 3.54 in $Q = CLH^{3/2}$

On Sept. 26, 1975 head on crest was measured as 16 inches. Add 2 inches to allow for drop in nappe. Use $H = \frac{18}{12} = 1.5$ ft

$Q = CLH^{3/2} = 3.54 \times 115 \times (1.5)^{1.5}$

$= 750$ cfs (official readings are obtained by measuring up from pin set in crest)

Warm water outlet at pool elev. 1088.12. There is a 20"x36" sluice gate with invert at 1066 ft. Estimate discharge

$Q = Ca\sqrt{2gh}$, $C = 0.545$, $a = 1.67 \times 3.0 = 5$ ft^2.

$2g = 64.3$; $h = 1088.12 - 1066 + 1.5 = 23.62'$

$Q = 0.545 \times 5 \times \sqrt{64.3 \times 23.62} = 2.725\sqrt{1519}$

$= 106$ cfs Use 110

Diversion tunnel low pool outlet at pool elevation 1035 ft. Control tower is 40 ft upstream from centerline of dam. Intake is cast iron pipe, inside dia. 2.50 ft, Length 100 ft. Outlet is similar pipe 185 ft long. Upstream invert 1035, Downstream invert 1030.

$V = \frac{0.590}{n} \times d^{2/3} S^{1/2}$

$V = \frac{0.590}{0.015} \times (2.50)^{2/3} \times (0.0132)^{1/2}$

$n = 0.015$

$d = 2.50$

$S = \frac{1035 - 1031.25}{285} = 0.0132$

$= 39.3 \times 1.84 \times 0.115$

$= 8.32$ $Q = VA = 8.32 \times \pi \times (1.25)^2 = 40.8$ cfs

Use 40 cfs

PROJECT Dam Investigations SHEET NO. 2 OF 5

SUBJECT Birch Run Reservoir Dam I.D. No. 329

COMPUTED BY EEC DATE 4-27-78 CHECKED BY JJP 5-4-78

Diversion tunnel outlet at pool elevation 1088.12 ft.

$$V = \frac{0.590}{n} \times d^{2/3} \times S^{1/2}$$

$$= \frac{0.590}{0.015} \times (2.50)^{2/3} \times (0.200)^{1/2}$$

$$= 39.3 \times 1.84 \times 0.447$$

$$= 32.32 \text{ ft/s}$$

$$Q = VA = 32.32 \times \pi \times (1.25)^2$$

$= 158.7$ cfs Use 160 cfs

$n = 0.015$

$d = 2.50$

$S = \frac{1088.12 - 1031.25}{285} = 0.200$

Ungated spillway capacity at maximum pool elevation 1096.0 ft (top of dam)

$$Q = CLH^{3/2}$$

$$= 3.54 \times 119 \times (7.88)^{3/2}$$

$= 9,318$ cfs

Use 9,300 cfs

$C = 3.54$

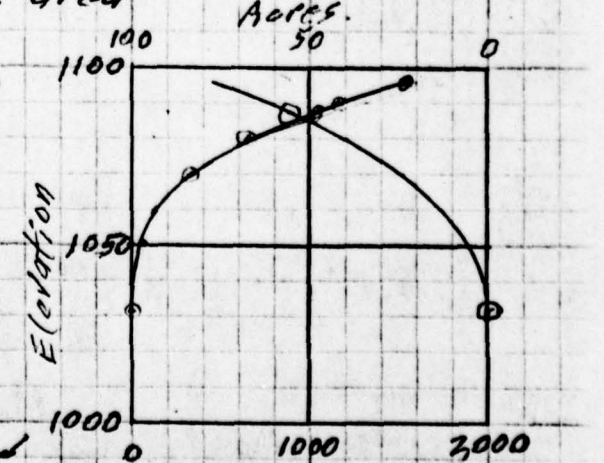
$L = 119$

$H = 1096 - 1088.12 = 7.88$

In original application it was said that spillway would pass 9,500 cfs. However 1.5 inches of shotcrete was added to crest of spillway in 1971.

Reservoir volume and area

Elev	Diff (ft)	Area (ac)	Vol (ac-ft)	Cum (ac-ft)
1031		0		0
	9		45	
1040		1		4
	10		35	
1050		6		39
	10		95	
1060		13		134
	10		190	
1070		25		324
	10		325	
1080		40		649
	8.1		386	
1088.1		55.2		1035
	1.9		111	
1090		62		1146
	6.0		417	
1096		77		1563



These curves were computed on basis of lake area on USGS Topo sheets

PROJECT Dam Investigation SHEET NO. 3 OF 2

SUBJECT Birch Run Reservoir Dam ID No. 329

COMPUTED BY RES DATE 4-28-78 CHECKED BY JJP 5-4-78 6-15-78

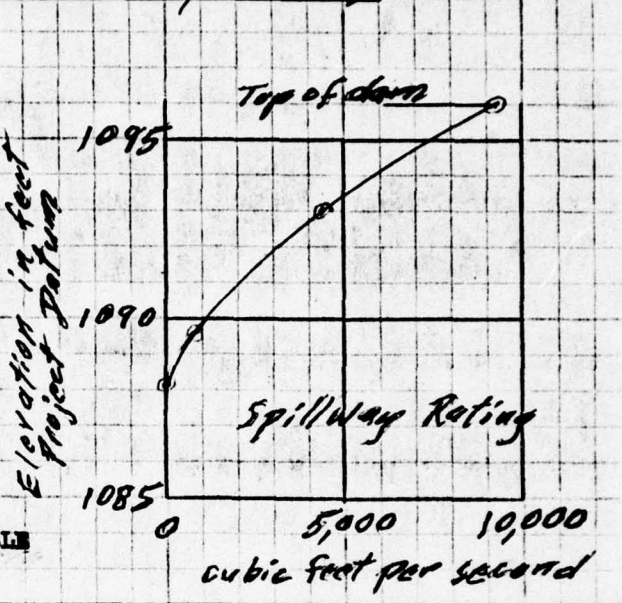
Spillway Rating to elev. 1096.0 (Top of dam)

At 1093.0 ft
H = 4.88 ft
C = 3.54
L = 115

$Q = CLH^{3/2}$

$= 3.54 \times 115 \times (4.88)^{3/2}$

$= 4460$ cfs



Overtopping Potential

	Square Miles
Drainage area of Long Pine Run Dam which is 1.5 miles upstream from Birch Run Dam	7.92
Uncontrolled drainage area between these two dams	6.38
Drainage area of Birch Run Reservoir Dam	14.3

Recent Snyder-type PMF calculation by the designer of Long Pine Run Dam gave an inflow to that reservoir of 14,700 cfs and an outflow of 13,700 cfs

	cfs
Long Pine Run Reserv. outflow =	13,700
Uncontrolled $\left(\frac{6.38}{7.92}\right)^{0.8} \times 14,700 =$	12,400
Assume timing of two peaks coincide Birch Run PMF inflow =	26,100

$\frac{\text{Max. Spillway Q}}{\text{Peak Inflow}} = \frac{9,300}{26,100} = 0.36$

$\frac{\text{Req. Resv. Storage}}{\text{Vol. of Inflow Hyd}} = 0.64$ From short cut method furnished by Balt. Dist. Corps of Eng.

PROJECT Dam Investigation SHEET NO. 4 OF 5

SUBJECT Birch Run Reservoir Dam ID No. 329

COMPUTED BY REL DATE 6-14-78 CHECKED BY JJP 6-15-78

Overtopping Potential (Cont.)

Assume Vol of Inflow Hydrograph equals 26 inches of 14.3 Sq. mi less storage in Long Pine Run Resv.

Total Vol = 26 x 14.3 x 53.33 = 19,800 ac. ft.

Long Pine Run storage = 2.40 - 1.75 = 0.65 Billion gals.
= 1,996 ac. ft.

Vol. of Inflow Hyd = 19,800 - 2,000 = 17,800 ac. ft.

Req. Resv. storage = 0.64 x 17,800 = 11,400 ac. ft.

Available storage = 1563 - 1035 = 528 ac. ft.

Dam will be overtopped by PMF

½ PMF

½ PMF inflow = $\frac{26,100}{2}$ = 13,000 cfs

$\frac{\text{Max Spillway Q}}{\text{Peak Inflow}} = \frac{9,300}{13,000} = 0.72$

$\frac{\text{Req. Resv. Storage}}{\text{Vol of Inflow}} = 0.28$

Assume Vol of Inflow = $\frac{17,800}{2}$ = 8,900 ac. ft.

Req. Resv. storage = 0.28 x 8,900 = 2,490 ac. ft.

Available storage = 528 ac. ft.

Dam will be overtopped by ½ PMF.

Size Classification

Total storage to top of dam. - 1,560 ac. ft.

Height 1096.0 - 1033.0 = 63 feet.

Use "Intermediate"

Hazard Classification Failure of the dam could cause damage and loss of life in Caledonia State Park and in several small towns downstream.

Use "High"

Recommended Spillway Design Flood (SDF)

The above classifications indicate an SDF equal to the PMF.

Spillway capacity is seriously inadequate since spillway cannot pass ½ PMF.

PROJECT Dam Investigation SHEET NO. 5 OF 7

SUBJECT Birch Run Reservoir Dam ID No. 329

COMPUTED BY RES DATE 6-15-78 CHECKED BY JJPJr 6-15-78

Discharge Rating Assuming Dam can withstand some overtopping

Top of dam is at elev. 1096.0.

For pool elevation 1098

Spillway $Q = CLH^{3/2}$ $C = 3.54$, $L = 119$

$H = 1098 - 1088.12 = 9.88$

$Q = 3.54 \times 119 \times (9.88)^{3/2}$

$= 13,080$ cfs

Dam $Q = CLH^{3/2}$ $C = 2.64$, $L = 670$

$H = 1098 - 1096 = 2$

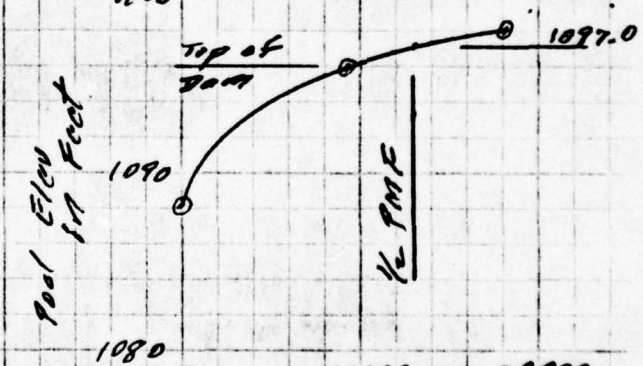
$Q = 2.64 \times 670 \times (2)^{3/2}$

$= 5,000$ cfs

Total $Q = 13,080 + 5,000 = 18,100$ cfs

If dam can withstand overtopping, 1/2 PMF, = 13,000 cfs, would result in flow about 1.0 foot deep over top of dam.

At 1.0 ft depth velocity would be about equal to "C" or 2.64 ft per sec.



APPENDIX C

GEOLOGIC REPORT

GEOLOGIC REPORT

Bedrock - Dam and Reservoir

Formation Name: Upper Montalto Member of the Harpers Formation.

Lithology: The Upper Montalto Member consists essentially of quartzite, composed of medium to coarse sized quartz grains, with some feldspar grains, cemented with quartz. Three varieties have been mapped in the vicinity of the dam. On the southeast side is a gray weathering, medium to coarse grained, slightly feldspathic white quartzite. Near the center of the dam is a 15 to 20-foot-thick layer of nearly pure, bluish quartzite. On the northwest side is a yellowish-orange weathering, medium to coarse grained gray quartzite. See reference (1).

Structure

The rocks of the area have been subjected to at least one episode of compression, resulting in overturned folds, faults parallelling the fold directions, cross faults, and the development of cleavage in the rocks. Cleavage, however, is rare in the Montalto Member.

The dam is located near the axis of an overturned syncline. Near the spillway the beds strike N65°E and dip 72°SE. Mapped faults parallel the reservoir on both sides of the valley, and a cross fault is mapped crossing the valley northeast of the upper end of the valley.

There is evidence that the dam and reservoir are underlain by an unmapped fault or shear zone. The geologic map of the Caledonia Quadrangle shows that the usual topographic expression of the Upper Montalto member is a ridge or hillside. Here, however, Conococheague Creek has eroded a valley right up the middle of the outcrop.

The core borings shown on the longitudinal section of the dam show an anomalous zone near the center of the valley. On the north side of the valley and logs show the bedrock to be brown to gray "sandstone" and some "flinty sandstone", which would be typical of the upper part of the Upper Montalto Member. Four holes near the center of the valley (all about 50 feet deep) encountered no bedrock at all.

Below the alluvium were interlayered gray, white and yellow clays, with some gray shale and brown sandstone. South of these holes, one hole apparently intersected interbedded gray shale and white

sandstone. Still further south, on the valley side, normal white sandstone was encountered.

There are two possible interpretations of this zone. The first is that it is an infaulted, infolded, slice of deeply weathered and altered Tomstown Dolomite. The core description is reminiscent of exposures in the Philadelphia Clay Company pit at Toland, Pa., near Mt. Holly Springs, Pa., about 18 miles northeast of the Chambersburg Reservoir. Here, the Montalto Member is in contact with white clay, and contorted beds of gray to purplish red silty shale which have been interpreted as deeply altered Tomstown Dolomite - from which all of the carbonate minerals have been leached. See reference (4). The second possibility is that the clays and shales occupy a fault zone or shear zone in which the quartzite beds (which contain some feldspar) have been extensively ground up leaving silt size quartz fragments coated with clay derived from the weathering of feldspar.

Overburden

The Upper Montalto Member generally weathers fairly deeply, and bedrock exposures are not common. The soil is sandy and poor with many quartzite boulders. All the core borings, except one at the south end, start in sand and gravel, alluvium in the flood plain of Conococheague Creek. The alluvium is 12 to 17 feet thick, somewhat thinner over the clay zone. On the south side of the valley, material logged as clay, shale, sand and gravel, boulders, etc., is probably deeply weathered Upper Montalto Quartzite. It is more than 20 feet thick.

Aquifer Characteristics

The Upper Montalto Member is composed of essentially impermeable rock. Groundwater moves almost entirely on tight bedding planes and fractures. Where the overburden is thick, some weathered material probably lies below the water table. Here, there would be substantial storage of water in the more porous overburden, and the upper surface of the bedrock could be a favored zone for groundwater movement. No data are available on the permeability of the white and yellow clay zone. If the clays were developed by hydrothermal action in the past they might be quite impermeable now, due to later compaction. If they were formed by normal meteoric groundwater movement they might represent a more permeable zone.

Discussion

There appears to be two areas of possible geologic hazard at this dam. The clay zone near the abutment of the dam is a possible source of leakage. Leakage in this zone might become more serious with time because of the unconsolidated nature of the material. The relatively thick overburden on the south side of the valley may indicate the bedrock was more fractured and weaker there. As noted above, the top of the bedrock may have been a zone of groundwater movement before construction. Since this area was not grouted, leakage could increase with time by removal of fine particles in the fractured rock.

Sources of Information

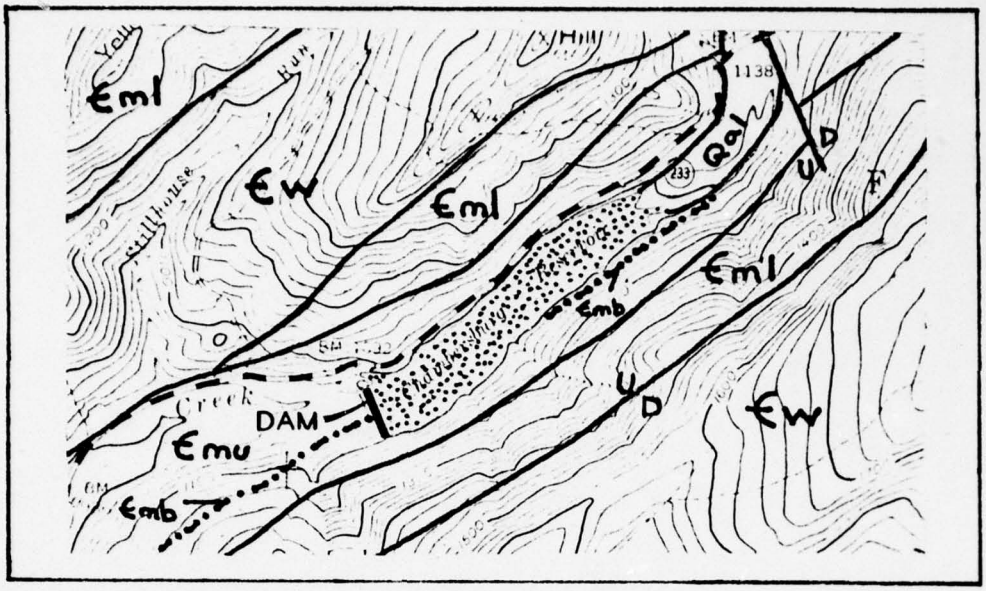
(1) Fauth, John L. (1968) Geology of the Caledonia Park Quadrangle Area, South Mountain, Pa. Pa. Geological Survey 4th Series, Atlas 129a.

(2) Air Photos, Scale 1:24,000, dated 1968.

(3) Core borings on drawings dated 1932.

(4) Freedman, J. (1967) "Geology of a Portion of the Mount Holly Springs Quadrangle, Adams and Cumberland Counties, Pa." Geologicl Survey, 4th Series, Progress Report 169.

Figure 1.



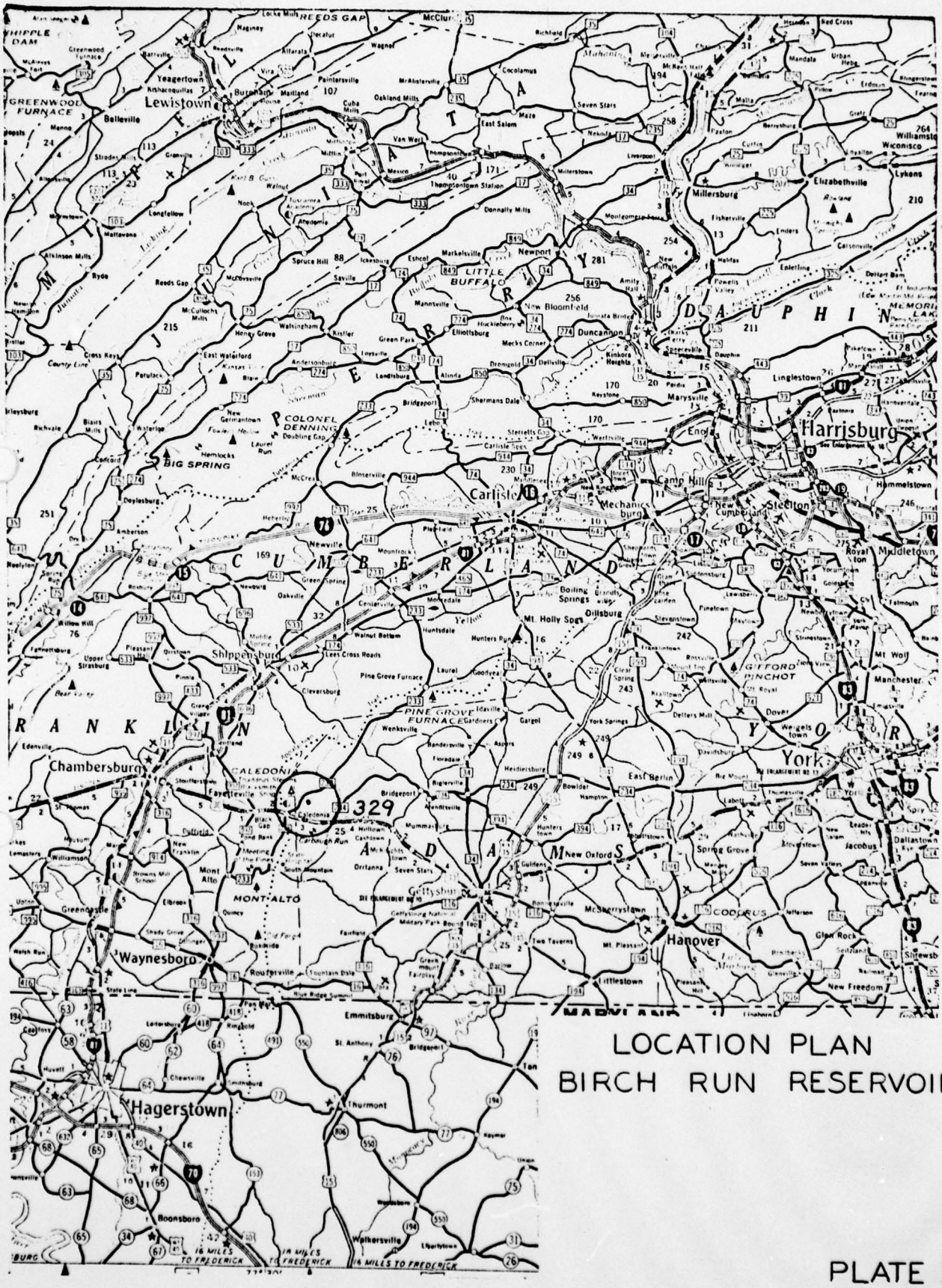
GEOLOGIC MAP - CHAMBERSBURG RESERVOIR

Qal	Alluvium	——	Lithologic Contact
Emu	Upper Montalto Member	U / D	Fault Contact
-·-·-	Blue Quartzite (in Upper Montalto)	⊬	Strike & Dip of Bedding
Ew	Lower Montalto Member		

(Geology from PAGS Bulletin 129a)

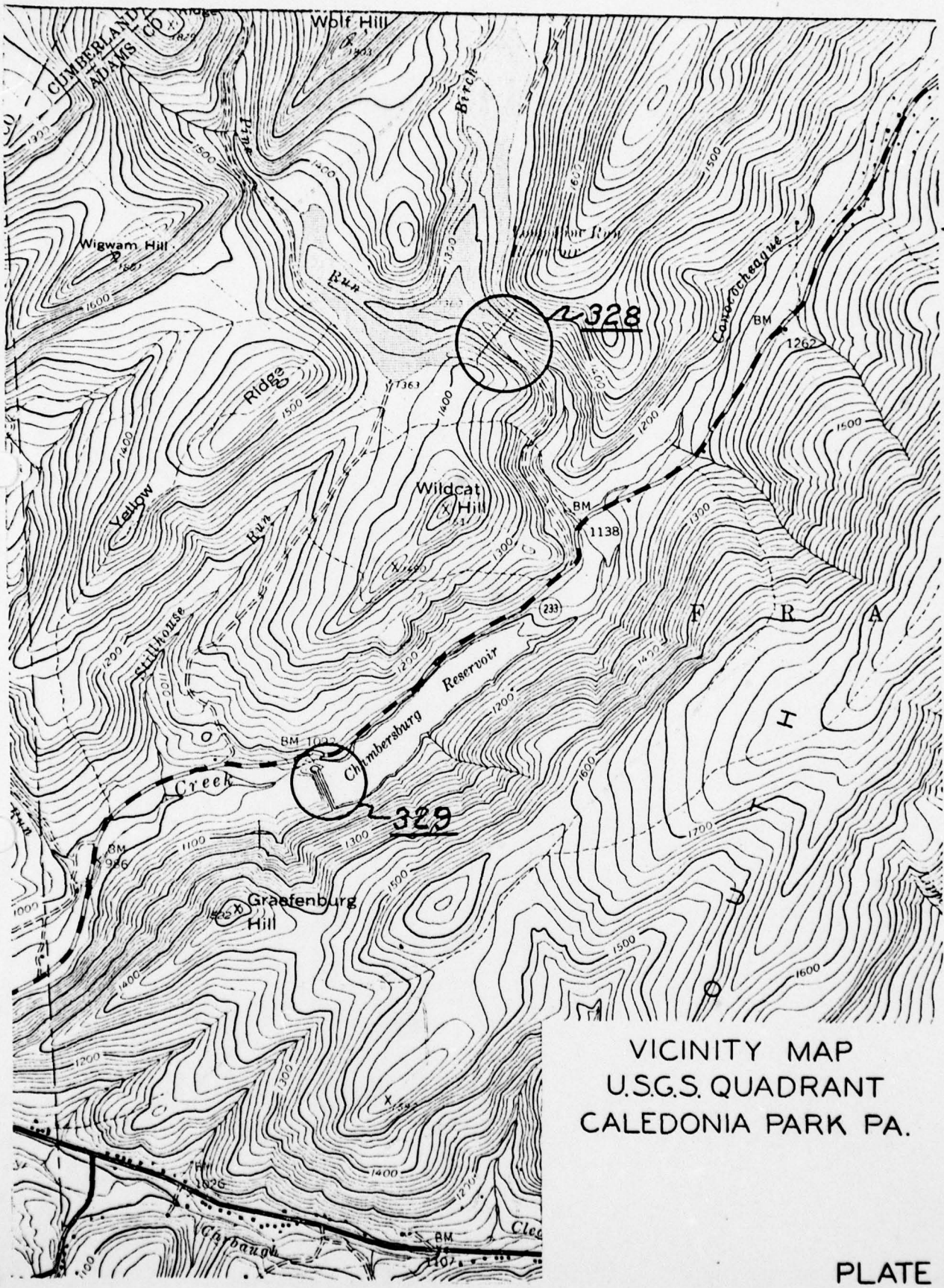
APPENDIX D

LOCATION, PHOTOGRAPHS & DESIGN DRAWINGS



LOCATION PLAN
BIRCH RUN RESERVOIR

PLATE I



VICINITY MAP
U.S.G.S. QUADRANT
CALEDONIA PARK PA.

PLATE II

Top of Dam
Looking South

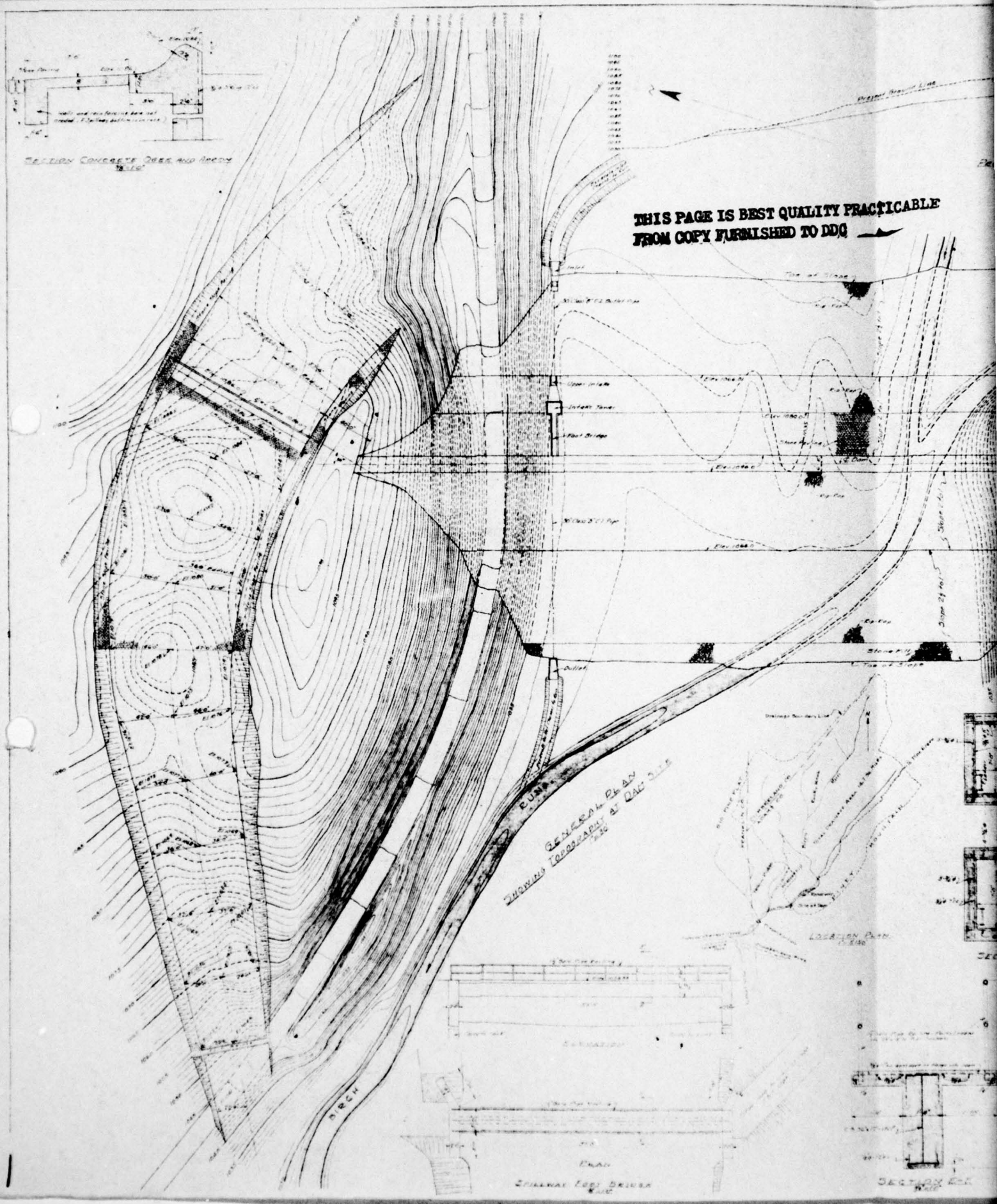
Downstream
Embankment

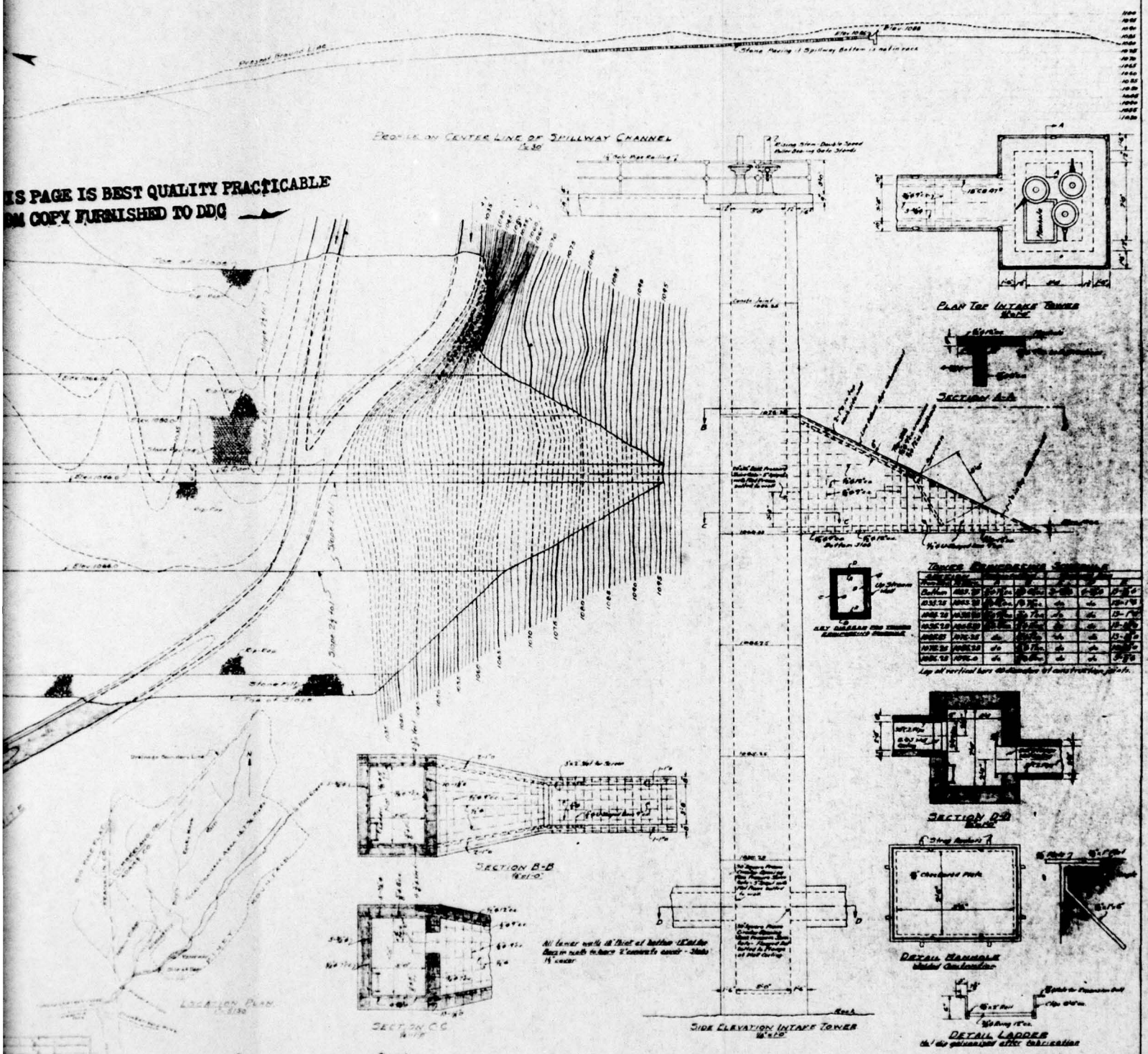
PLATE III

Downstream
Embankment
Slope

Weir at
Right Abutment

PLATE IV





329

PLATE V

DAM & RESERVOIR ON BIRCH RUN

ADAMS COUNTY, PENNA.

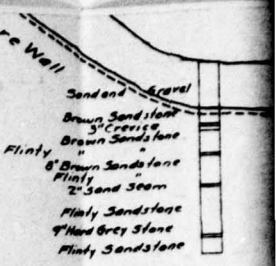
FOR

BOROUGH OF CHAMBERSBURG, PENNA.

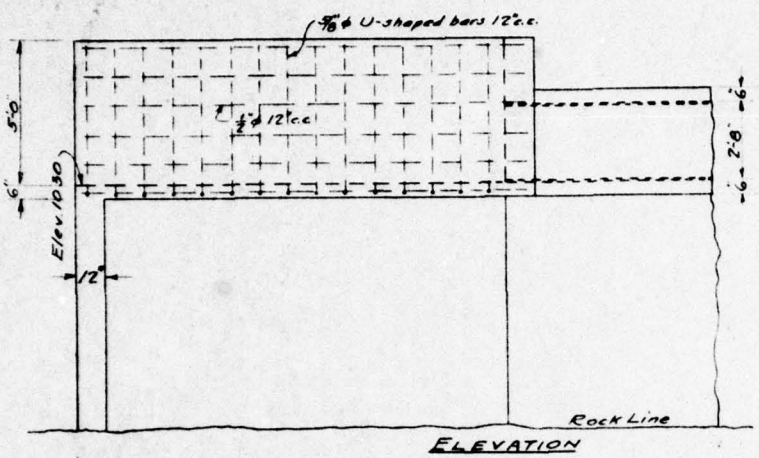
GANNETT, SEELYE & FLEMING ENGRS. INC.

HARRISBURG, PA.

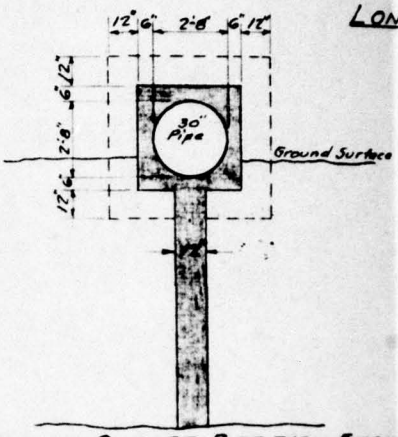
SCALES AS SHOWN. OCTOBER, 1932.



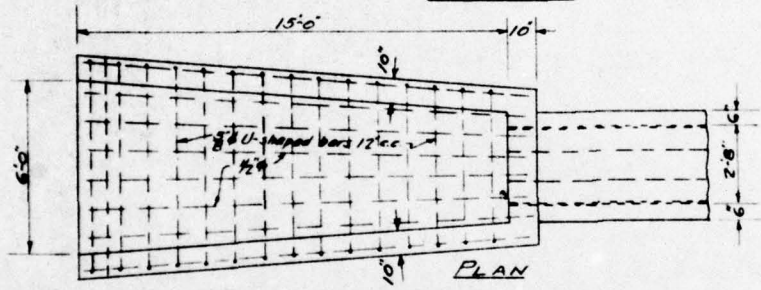
LONGITUDINAL



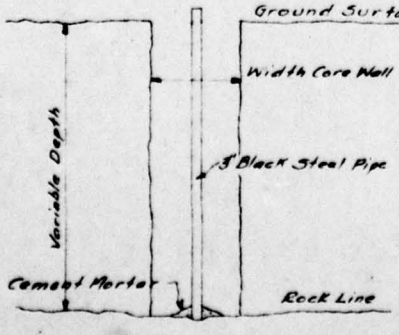
ELEVATION



SECTION OUTLET PIPE THRU EMBANKMENT
1/4"=1'-0"

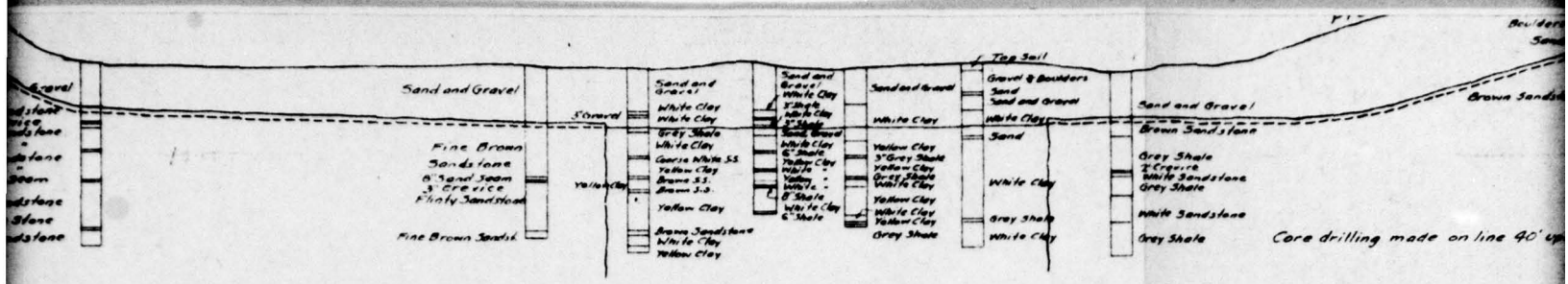


DETAIL CONCRETE OUTLET
1/4"=1'-0"



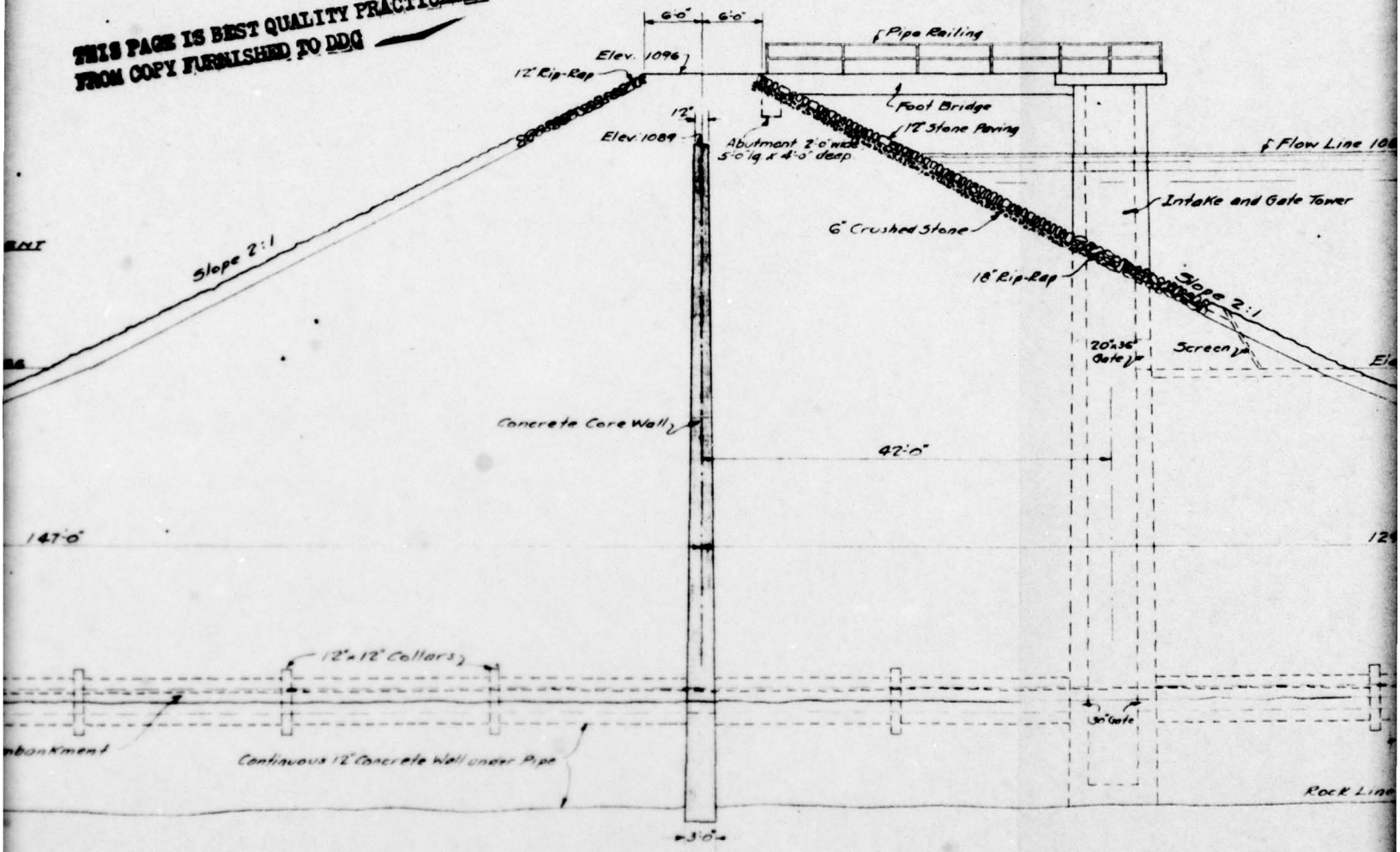
ELEVATION GROUT PIPE

Clean rock in bottom of Core Wall Trench and set pipe where directed by Engineer. Brace rigidly in vertical position and place mortar around pipe. After mortar sets place concrete in trench or forms using care not to displace pipes. When concrete is poured to surface of ground proceed with diamond drill borings to depths as determined by Engineer.



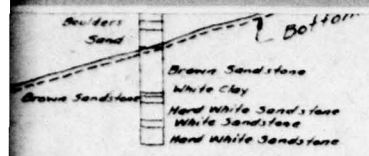
TUDINAL SECTION ALONG CENTER LINE DAM AND SPILLWAY OGEE

20'=1"



TYPICAL CROSS SECTION DAM

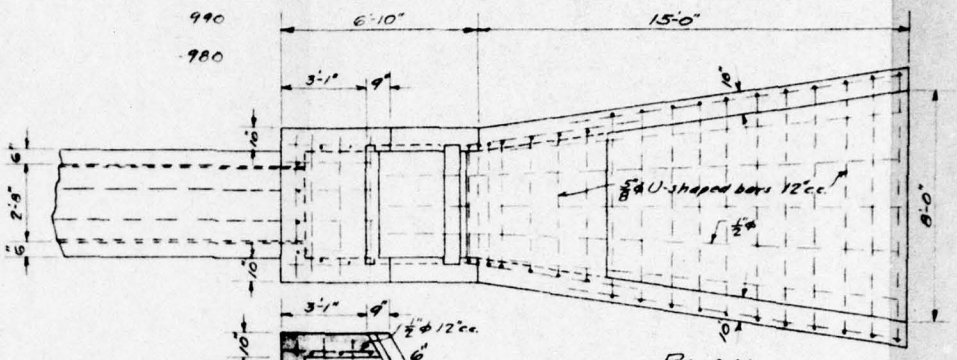
1"=10'



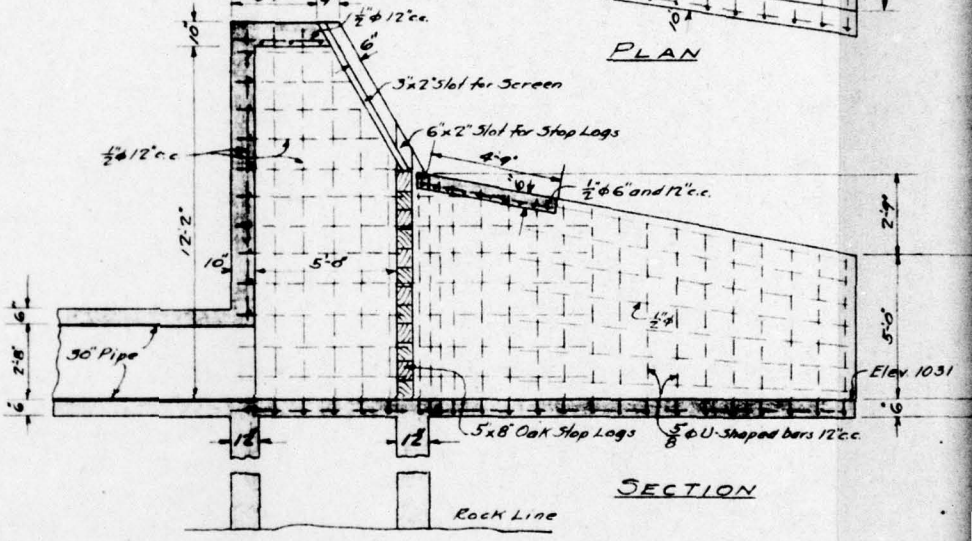
DETAIL SCREEN FOR INLET & UPPER INTA
Hot dip galvanized after fabrication.

line 40' upstream from center line of dam.

1040
1030
1020
1010
1000
990
980



PLAN



SECTION

ow Line 1088

Tower

Elev. 1066

Slope 2.5 : 1

12'-0"

Inlet

18" Rip-Rap

Screen

30" Class B" C.I. Pipe

Present Ground Line

Elev. 1031

Concrete Casing

Rock Line

DETAILS CONC
1/4"=

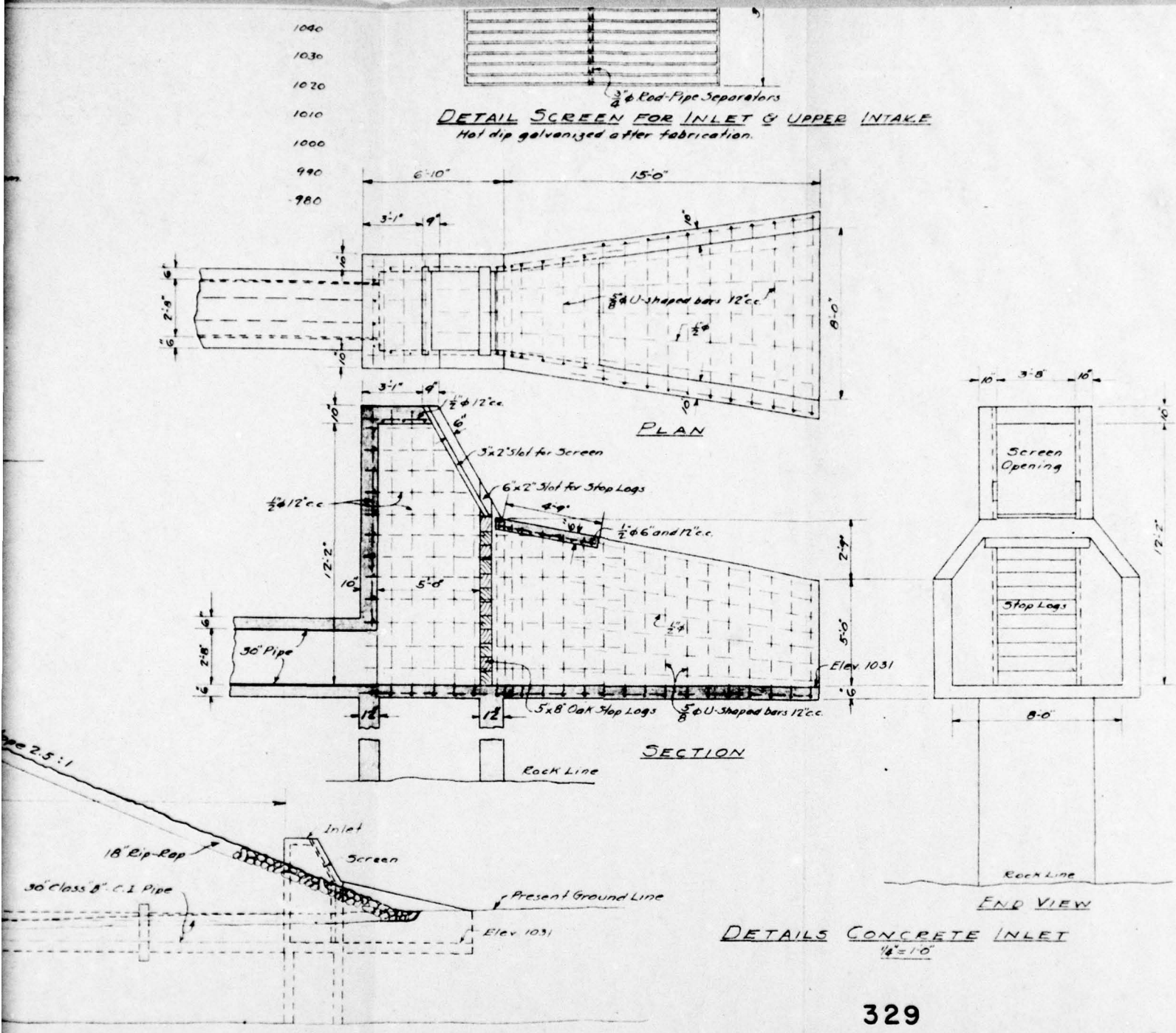
32

DAM & RESE
ON
BIRCH R
ADAMS COUNTY
FOR
BOROUGH OF CHAMBE
GANNETT, SEELYE & FLE
HARRISBURG

SCALES AS SHOWN.

PL

3



DETAIL SCREEN FOR INLET & UPPER INTAKE
Hot dip galvanized after fabrication.

DETAILS CONCRETE INLET
1/8" = 1'-0"

329

DAM & RESERVOIR
ON
BIRCH RUN
ADAMS COUNTY, PENNA.

FOR

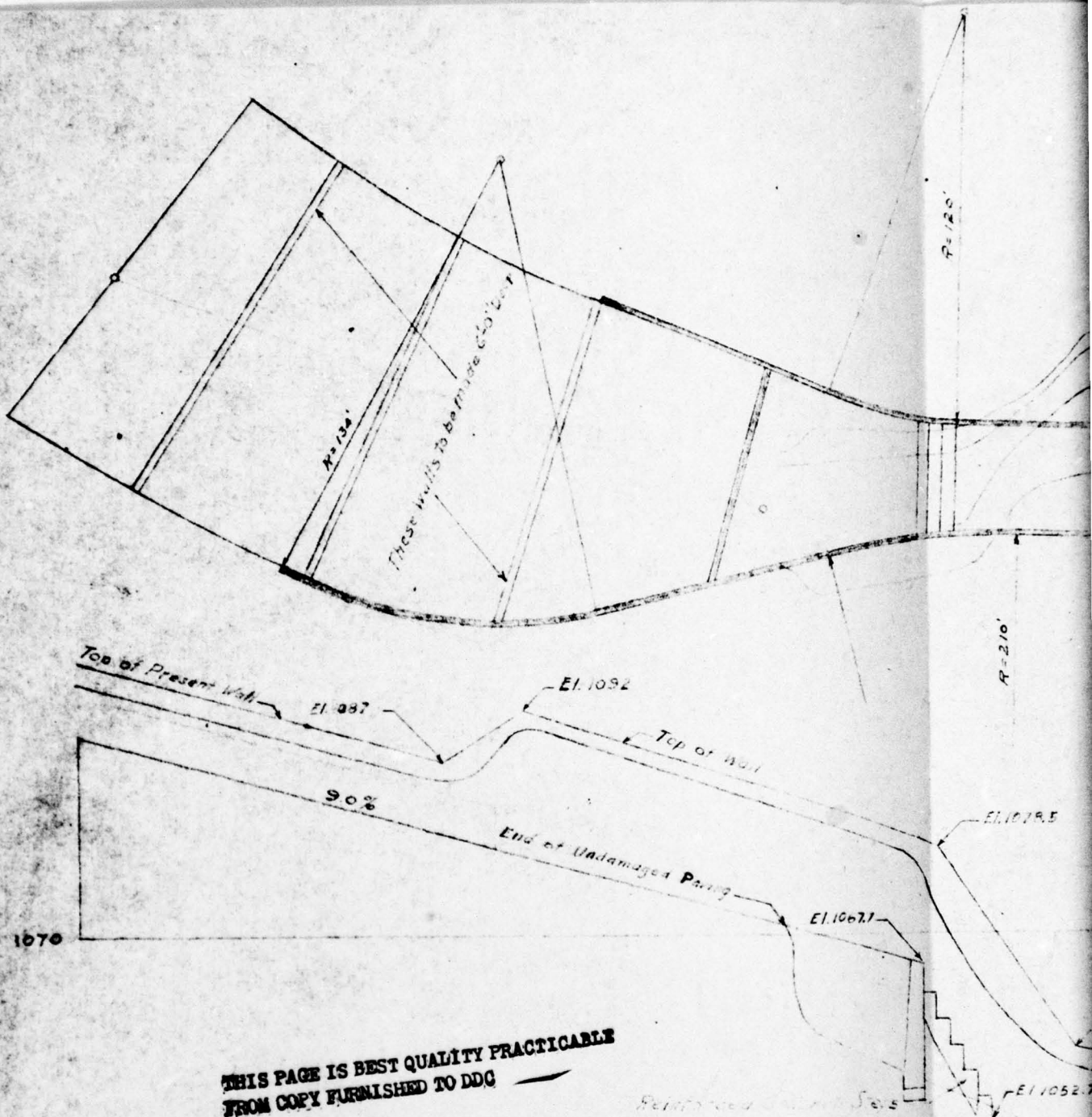
BOROUGH OF CHAMBERSBURG, PENNA.

GANNETT, SEELYE & FLEMING ENGRS., INC.
HARRISBURG, PA.

SCALES AS SHOWN. OCTOBER, 1932.

PLATE VI

1-3823.

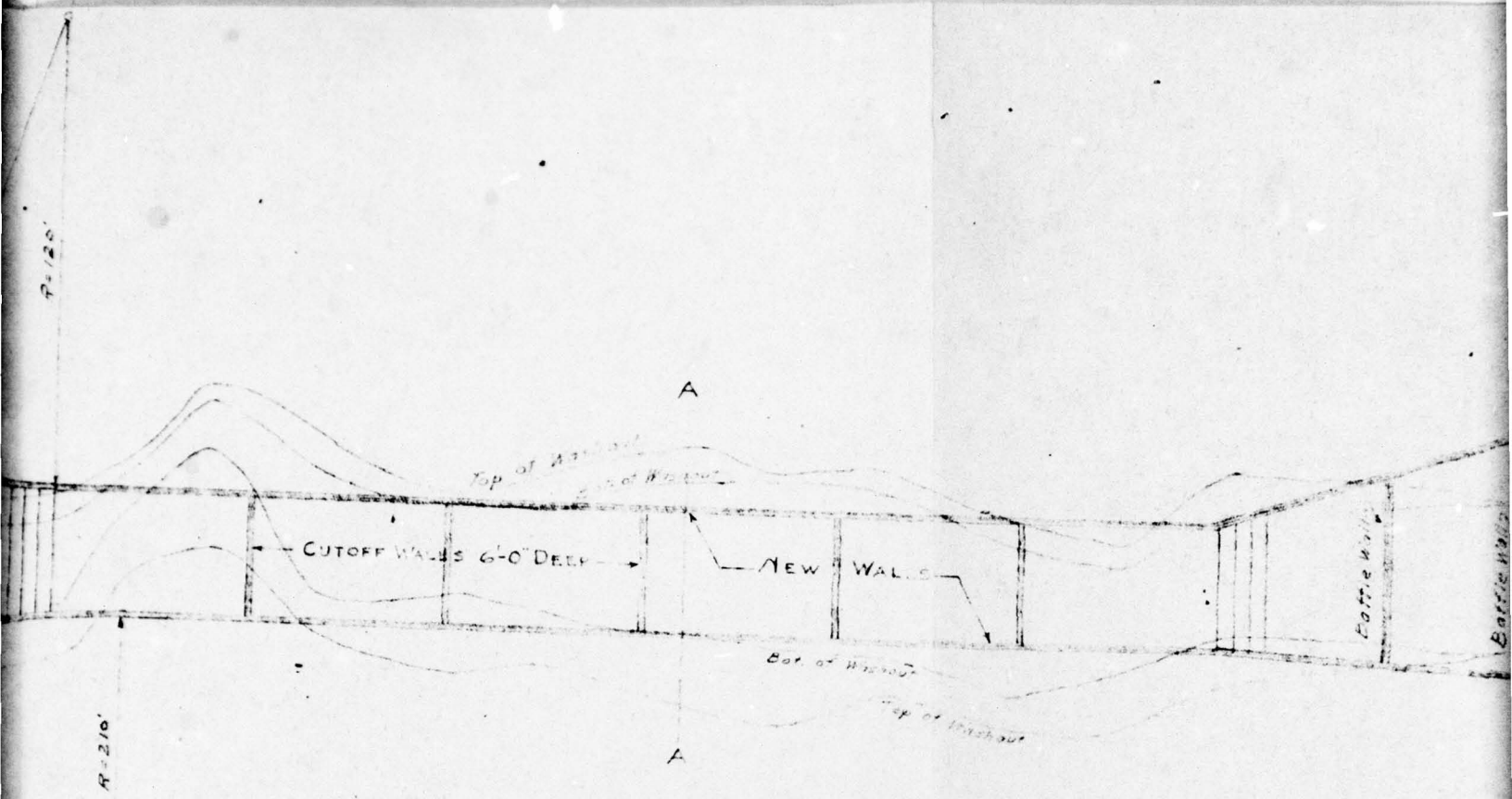


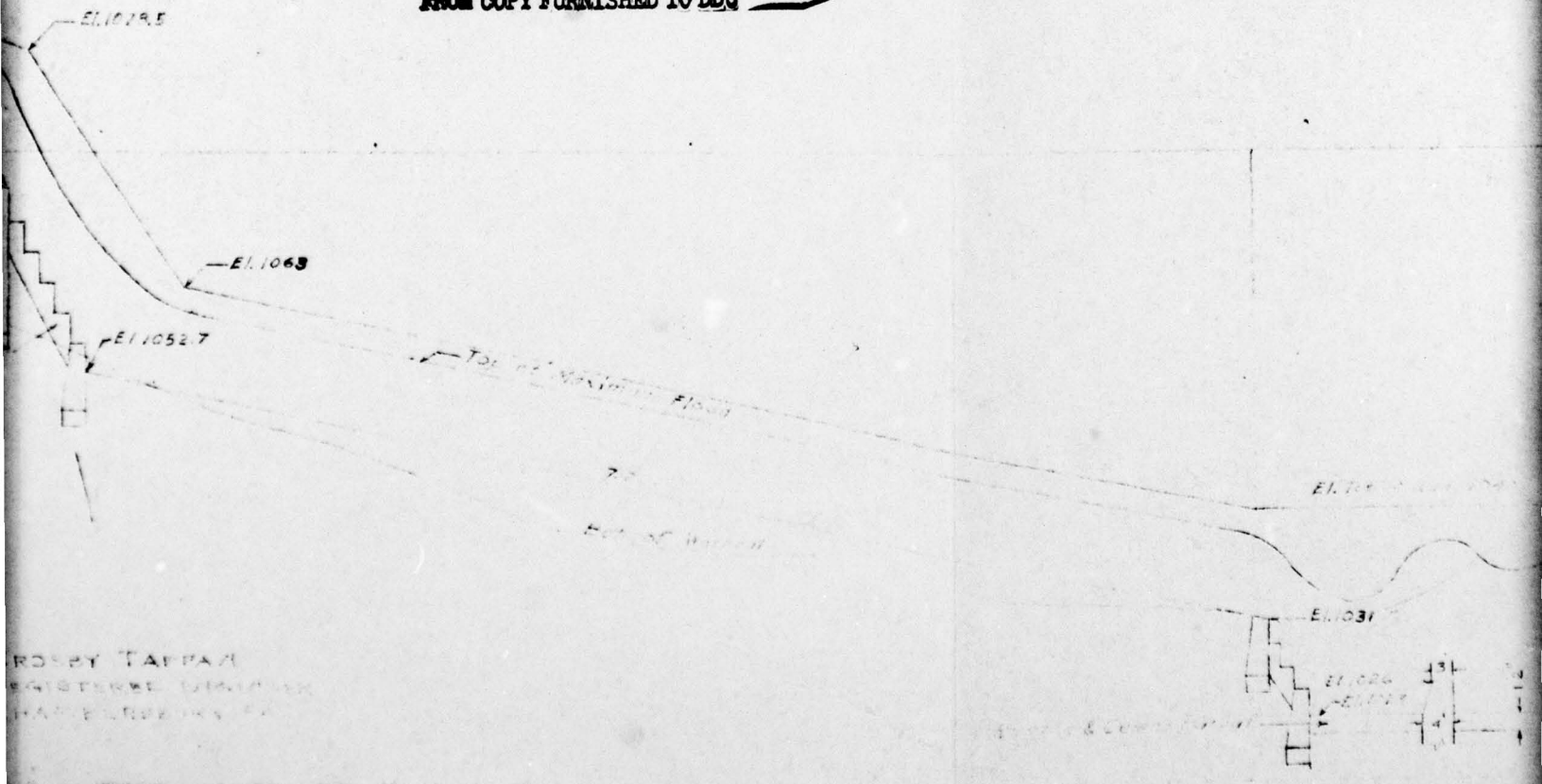
PLAN
FOR RECONSTRUCTION OF
SPILLWAY CHANNEL
CHAMBERSBURG RESERVOIR
CHAMBERSBURG, PA.
SCALE 1" = 30' JUNE 1947

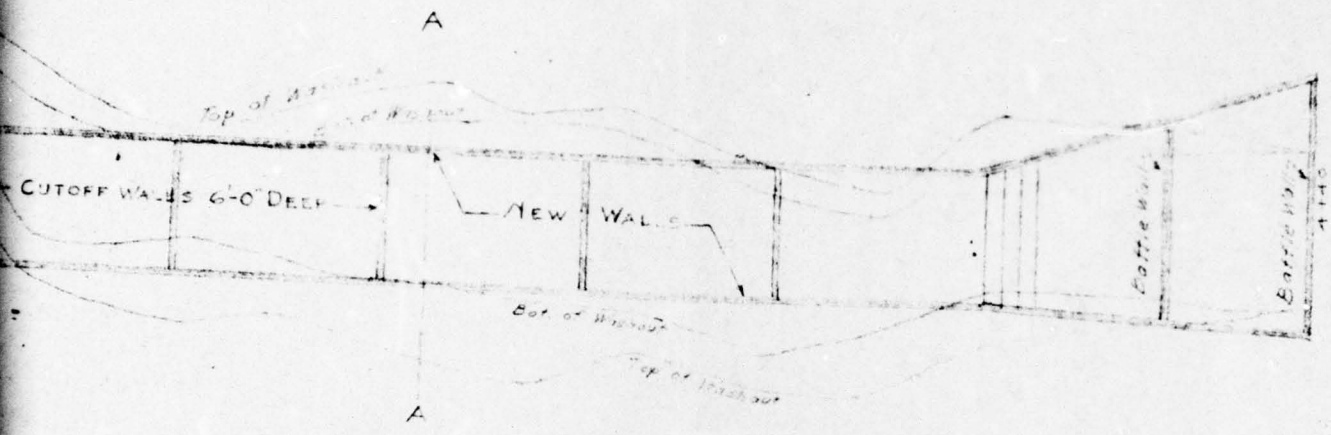
PROFILE
HOR. 1" = 30'
VER. 1" = 10'

CROSBY TAIT
REGISTERED
CHAMBERSBURG

No. S-C1







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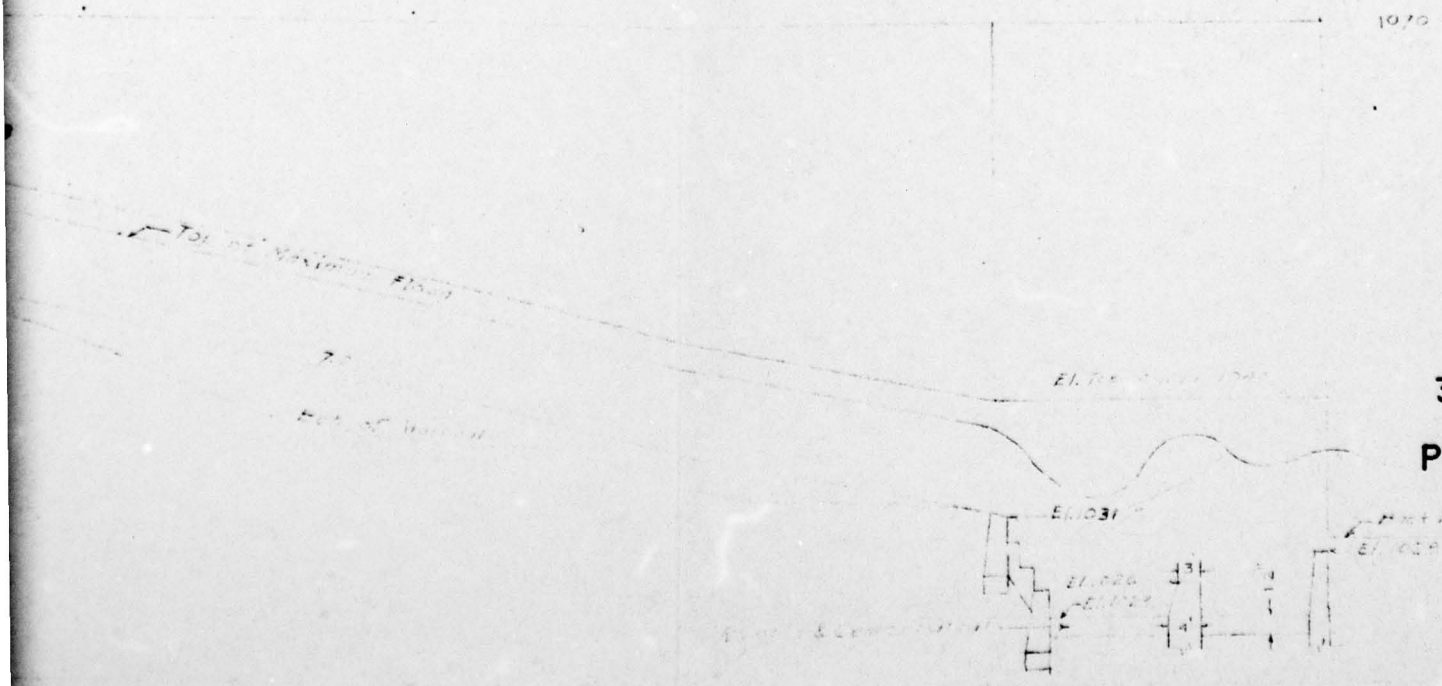

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PLATE VII